DENSITY

Objective

-To measure the mass and volume of samples of different metals

-To calculate the density of unknown metals

-To graph the combined class data and use the data to determine whether there is any constant relationship between the mass and the volume of a given substance

Safety: Do Not touch lead (Pb) with bare hands, use forceps

Introduction

Mass is a measurement of the amount of matter in a sample, while volume is a measurement of the space occupied by a sample of matter. Mass measurements are made on different types of balances. An electronic balance is commonly used because it gives fast results on a digital display.

Volume measurements are made in different ways depending upon the physical state of the sample being measured. The volume of a liquid is commonly measured in a graduated cylinder. The surface of the liquid curves upward where it contacts the cylinder walls. This curved surface is called a ***meniscus***. Measurement of volume in a graduated cylinder is always made by reading the mark at the bottom of the meniscus with the eye positioned at the level of the liquid surface.

The volume of a solid may be calculated from its dimensions (LxWxH), if the solid is regular and free of air space. However, if the solid is irregular or contains air space, its volume must be determined in another way, such as by ***water displacement***.

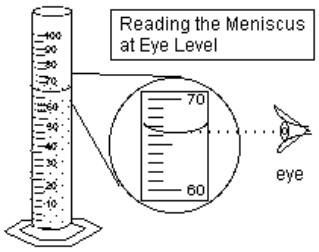
Procedures

1. Obtain clean, dry samples of three different metals. Write down which unknowns you have; they correspond to the answer key.

2. Measure the mass of each metal, using the maximum number of decimal places allowed by the balance. Record in Data Table 1.

3. Measure the volume of each metal separately:

a) Fill a graduated cylinder halfway with sink water.
b) Tap out any air bubbles.
c) Record initial volume to 0.1 mL in Data Table 1.
d) Tilt the cylinder gently and slide the metal into it. It must be submerged.
e) Tap out any air bubbles.
f) Record final volume to 0.1 mL in Data Table 1.



4. When finished, carefully pour out the water and metal into your hand. Dry the metal samples and give them to the teacher.
5. You should complete three trials of each metal (different amount each time)

Calculations

1) Calculate the volume of *each* of the metals you tested:

Volume of metal = (Final Volume water) – (Initial Volume water) in mL

2) Calculate the density of *each* metal, $Density = \frac{Mass}{Volume}$ Use the proper units and sig. figs.*

-Record your individual lab station data on the "Class Data Table."

- graph all the metals on the same graph. Copy down all class data pertaining to the metals for % error calculations.

-Set up a graph in excel that shows all of your metals samples. Be sure to title it.

-Plot a graph of the class data using MASS as y axis and VOLUME as x axis.
- Add a "best-fit line" through the data points and (0,0).

3) Determine the slope of the lines by choosing two points *directly on the line*:

$$Slope = \frac{Rise}{Run} = \frac{y_2 - y_1}{x_2 - x_1}$$

-The slope of the line is the density of the metal (M/V). Record slope in Data Table 2.
-Look at the class density of the unknown metal you graphed, which is the slope.
-Examine your own lab group's density for the same unknown.
-Record the standard density, given by Mr. Golden, of the unknown that you graphed.

Calculate two percent errors:

$$\%\ Error\ Of\ Class\ = \frac{Standard\ -\ Class\ Density}{Standard} \times 100$$

$$\%\ Error\ Of\ Your\ Lab\ Group\ = \frac{Standard\ -\ Group\ Density}{Starndard}\ x\ 100$$

Data Table 1:

MASS, VOLUME, DENSITY			
	Metal	**Metal**	**Metal**
mass (g)			
initial volume of water (mL)			
final volume of water (mL)			
Change in water volume (mL)			
volume of metal (cm^3) 1mL= $1cm^3$			
density of metal (g/ cm^3)			

Data Table 2:

Density As A Slope Function			
Unknown metal graphed? (A, B,C, D…)			
slope of the line			
standard density value of the graphed unknown (from teacher)			
class percent error			
lab group percent error			

Questions

1) Why does a pure substance always have the same density? Given descriptive supporting evidence

2) Describe how water displacement works for finding volume and list three (3) examples of where it could be used in your life outside of school.

3) What is a meniscus and how is it used in a graduated cylinder? (You may need to research this one)

4) Can density be used as identification for substances in lab? Why or why not?

5) Which was more accurate, your own lab groups data or the class data?

6) List three (3) sources of experimental error and how you could remedy/ avoid them if repeating experiment?